Institute of Biodiversity and Environmental Conservation

Pollination Guilds of Aroids in Mulu National Park

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgement has been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

The aroid flora of Borneo is one of the richest on the planet, comprising at least 800 species with many highly localized endemics. Not surprisingly, most of our knowledge of these taxa is limited to naming taxonomic novelties but beyond this, our knowledge on the pollination biology of Bornean aroids remains poor. Previous pollination research on aroid taxa on Borneo, revealed two pollination guilds: Diptera (Drosophilidae) and Coleoptera (Chrysomelidae, Hydrophilidae, and Staphylinidae) which are by far the major pollinating groups. This study was conducted at Gunung Mulu National Park, an area which hold one of the richest aroid diversity on Borneo, and aimed to determine pollinators of 21 selected aroids belonging to Tribe Aglaonemateae, Anadendrieae, Colocasieae, Homalomeneae, Monstereae, Potheae, Schismatoglottideae, and Thomsonieae. Extensive field observations on floral biology including stages of floral development, floral traits and rewards, identification of insect pollinators, and their behaviour(s) were carried out. The total anthetic time of most unisexually flowered taxa (*Alocasia*, *Aglaonema*, *Homalomena*, and Schismatoglottideae) lasted for two days, except *Amorphophallus* which ranged two to five days. In bisexually flowered taxa, *Scindapsus* completed anthesis in two days but anthesis lasted four days in *Anadendrum* and longer in *Lasia* and *Pothos*, which ranged 7-18 days. All investigated aroid taxa emitted floral odour during pistillate anthesis with several taxa (*Anadendrum*, *Bucephalandra*, *Homalomena*, *Pothos*, and *Schismatoglottis pellucida*) extended odour production until the end of anthesis. Some taxa (*Amorphophallus* and *Pothos*) do not restrict access to the pistillate flowers during pistillate anthesis. Diptera flies are the most possible pollinators for *Alocasia*, *Aglaonema*, *Homalomena*, *Pothos*, Schismatoglottideae and *Scindapsus*; Coleoptera beetles are the pollinators for *Amorphophallus*, *Anadendrum*, *Homalomena*, *Lasia*, and *Schismatoglottis*; Thysanoptera

(thrips) are the pollinators of *Anadendrum*; Hemiptera are pollinators of *Lasia* and *Pothos*; Hymenoptera are pollinators of *Alocasia sarawakensis* and *Amorphophallus hewittii*. Floral rewards for pollinators included stigmatic secretion, floral tissues, and provision of mating sites.

Keywords: *Amorphophallus, Anadendrum,* anthesis, *Lasia*, pollinators

Kumpulan Pendebungaan Keladi Hutan di Taman Negara Mulu

ABSTRAK

*Flora keladi hutan Borneo adalah salah satu yang terkaya di planet ini, dengan sekurang-kurangnya 800 spesies yang terdiri daripada banyak endemik tempatan. Tidak menghairankan, kebanyakan pengetahuan tentang keladi hutan tersebut adalah terhad kepada penamaan taksonomi baru tetapi luar daripada ini, pengetahuan tentang biologi pendebungaan keladi hutan dari Borneo masih kurang. Penyelidikan pendebungaan tentang keladi hutan di Borneo sebelum ini, mendedahkan dua kumpulan pendebunga: Diptera (Drosophilidae) dan Coleoptera (Chrysomelidae, Hydrophilidae, dan Staphylinidae) yang merupakan kumpulan pendebunga utama. Kajian ini dijalankan di Taman Negara Gunung Mulu, salah satu kawasan yang mempunyai kepelbagaian keladi hutan terkaya di Borneo, dan bertujuan untuk menentukan pendebunga untuk 21 keladi hutan terpilih daripada Tribe Aglaonemateae, Anadendrieae, Colocasieae, Homalomeneae, Monstereae, Potheae, Schismatoglottideae, dan Thomsonieae. Pemerhatian lapangan secara meluas mengenai biologi bunga termasuk peringkat perkembangan bunga, sifat bunga dan ganjaran, pengenalpastian pendebunga serangga, dan tingkah laku mereka telah dijalankan. Jumlah masa antesis untuk kebanyakan keladi hutan berbunga uniseks (*Alocasia, Aglaonema, Homalomena, *dan Schismatoglottideae) berlangsung selama dua hari, kecuali* Amorphophallus *yang berjulat antara dua hingga lima hari. Untuk keladi hutan berbunga biseks,* Scindapsus *menyempurnakan proses antesis dalam dua hari tetapi antesis bertahan selama empat hari di* Anadendrum *dan lebih lama di* Lasia *dan* Pothos*, yang berjulat antara 7-18 hari. Semua taxa keladi hutan mengeluarkan bau bunga semasa antesis pistillate dengan beberapa keladi hutan (*Anadendrum, Bucephalandra, Homalomena, Pothos*, dan*

Schismatoglottis pellucida*) mengeluarkan bau bunga sehingga antesis berakhir. Sesetengah keladi hutan (*Amorphophallus *dan* Pothos*) tidak mengehadkan akses ke bunga jantina semasa antesis pistillate. Lalat Diptera berkemungkinan besar adalah pendebunga untuk* Alocasia, Aglaonema, Homalomena, Pothos, *Schismatoglottideae dan* Scindapsus*; Kumbang Coleoptera adalah pendebunga untuk* Amorphophallus, Anadendrum, Homalomena, Lasia, *dan* Schismatoglottis*; Thysanoptera (thrips) adalah pendebunga untuk* Anadendrum*; Hemiptera adalah pendebunga untuk* Lasia *dan* Pothos*; Hymenoptera adalah pendebunga untuk* Alocasia sarawakensis *dan* Amorphophallus hewittii. *Ganjaran bunga untuk pendebunga termasuk cecair stigma, tisu bunga, dan penyediaan tapak mengawan.*

***Kata kunci**:* Amorphophallus, Anadendrum, *antesis*, Lasia, *pendebunga*

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